Pollution Engineering

by Carol Mouché, Contributing Editor

Federal Focus

Waterways Benefit from Sediment Decontamination

Every year, approximately 300 million cubic yards of sediment are dredged to deepen harbors and clear shipping lanes in the United States. As much as 12 million cubic yards of those sediments are contaminated with halogenated hydrocarbons, persistent organics, polycyclic aromatic hydrocarbons and metals such as lead, cadmium, zinc and mercury.

Dredging is an environmental challenge, but it also can have economic consequences, says Keith Jones, senior physicist in the Environmental Sciences Department at the Department of Energy's Brookhaven National Laboratory (BNL), Upton, N.Y. Consider, for example, the Port of New York/New Jersey (NY/NJ), which is the largest port complex on the East Coast of North America and is located at the hub of the most concentrated and affluent consumer market in the world. Surprisingly, its harbor is only about 19 feet deep — what Jones calls "naturally shallow." Yet modern container vessels need 45 feet of depth or more to navigate through the harbor's channels.

The port is "involved in a life-and-death struggle to stay in business," Jones says. On average, 2 million to 4 million cubic yards of sediment, enough to fill both of New York's World Trade Center towers, is dredged each year. "Without dredging, the next generation of big container ships will move on to other ports," he says. However, more than half of that sediment is contaminated, making it unsuitable for unrestricted ocean disposal. This has left state and federal officials scrambling for treatment and disposal options.

This Eastern Seaboard port is on the cutting edge of finding solutions for treating contaminated sediments and turning them into potentially marketable products, says Jones. Since 1994, BNL has been collaborating on a decontamination demonstration program for the Port of NY/NJ with the U.S. Environmental Protection Agency's (EPA) Region 2, the U.S. Army Corps of Engineers (USACE) New York District and Rensselaer Polytechnic Institute. The project is funded through appropriations from the Water Resources Development Acts (WRDA) of 1992, 1996 and 1999. It extends from testing at bench and pilot scales to large-scale commercialization of dredged-material processing centers and creation of an end product suitable for beneficial use.

Considered the largest East Coast port complex, the Port of NY/NJ is only about 19 feet deep.

Pollutant Profile

Five major types of pollutants are found in sediments, according to EPA:

- Nutrients, including phosphorous and nitrogen compounds such as ammonia. Elevated levels of phosphorous can promote unwanted growth of algae, which can lead to a decreased level of oxygen in the water when the algae die and decay. High concentrations of ammonia can be toxic to benthic organisms.
- Bulk organics, a class of hydrocarbons that includes oil and grease.
- Halogenated hydrocarbons or persistent organics, a group of chemicals very resistant to decay. Dichlorodiphenlytrichloroethane (DDT), polychlorinated biphenyls (PCBs) and dioxins are in this category.
- Polycyclic aromatic hydrocarbons, a group of organic chemicals that includes several petroleum products and byproducts.
- Metals, including iron, manganese, lead, cadmium, zinc and mercury, and metalloids such as arsenic and selenium.

Sediment processing

In 1998, EPA and USACE, working through BNL, awarded contracts for demonstrations of technologies designed to treat sediments dredged from the bottom of the harbor on a scale of up to 500,000 cubic yards/year. These sediment-cleaning technologies must be environmentally safe and cost-effective, and must work for the many different types of con-taminants found in dredged material in the harbor.

- BioGenesis Enterprises, Milwaukee, has teamed with Roy F. Weston Inc., West Chester, Pa., to implement a sediment-washing technique. The approach uses a high-pressure water jet and

proprietary chemical additives to extract both organic and inorganic contaminants from the sediments, says Charles Wilde, chief operating officer. The cleaned material is used as the basis for a fertile manufactured soil. This technology has concluded the pilot stage and will be installed on a site in Kearny, N.J., later this year. When operational, the facility will be capable of processing up to 40 cubic yards/hour and 250,000 cubic yards annually. The cleaned sediments will form the basis of manufactured soil. This $10 million, full-scale demonstration project, co-funded by BioGenesis, WRDA's sediment decontamination program and the state of New Jersey, is expected to begin later this year.

- Cement-Lock technology was developed and is being marketed by Endesco Clean Harbors LLC of Des Plaines, Ill., which is a wholly owned subsidiary of the Gas Technology Institute — a recent merger of the Institute of Gas Technology and the Gas Research Institute.

In the Cement-Lock process, contaminated sediments are mixed with inexpensive inorganic modifiers and then melted in the presence of oxygen to destroy organic contaminants and immobilize nonvolatile heavy metals within the solidified matrix, says Michael C. Mensinger, Endesco's director of technology development. The resultant material then is converted to salable, construction-grade cement.

Flue gases are passed through pollution-control equipment to remove particulates, sulfur oxides (if sulfur is present in the sediment) and other acid gases. Volatile heavy metals such as mercury are recovered using activated carbon. The cleaned flue gas containing carbon dioxide and water vapor (from combustion of natural gas) is discharged to the atmosphere.

Electric power can be produced from excess process heat for captive plant requirements and for export.

Construction of equipment for a Cement-Lock demonstration is complete and the unit is awaiting installation on a site close to Newark Bay, N.J. Initially the facility will be able to process 30,000 cubic yards a year. Operations are scheduled to begin early next year.

For more on a major dredging project, see page 16 of **Pollution Engineering's** *August 2000 issue.*

Decontamination technologies

The state of New Jersey has one of the most active dredged-material management/beneficial use programs in the country, says Jones. Scott Douglas, dredging program manager for New Jersey Maritime Resources (NJMR), Trenton, is overseeing a sediment de-contamination technologies demonstration project that received $20 million from the state's Dredging Bond Act last year to evaluate promising dredged material-processing solutions using test sediment from Newark Bay.

"We are trying to find out if any of the technologies that EPA is looking at are capable of treating navigational dredged material in a cost-effective manner — equal to or less than in-water disposal options," Douglas says. Five vendors have passed initial scrutiny and are involved in pilot and demonstration tests to destroy, remove or immobilize organic and metal contaminants and leave clean material that can be used to make manufactured soil or construction-grade cement and lightweight aggregate. Two of those vendors are BioGenesis and Endesco Clean Harbors LLC. The other three are:

"Decontamination is like manufacturing — you remove the contaminants and produce marketable products."

— Scott Douglas, NJMR

- JCI/Upcycle, New Providence, N.J., which uses existing rotary kilns for high-temperature processing. This technology dewaters the dredged material and turns it into pellets, which are heated and fused in an existing rotary kiln for use as a lightweight construction aggregate.
- NUI Environmental, Elizabeth, N.J., which is working on a sediment-washing technology similar to that of BioGenesis, according to Douglas.
- BEM Systems, Chatham, N.J., which will be testing an enhanced mineralization technology called georemediation. In this process, an additive speeds up the natural attenuation of metals and acts as a catalyst for the destruction of the organic compounds.

Adding value

New Jersey currently is dealing with dredged sediment in two basic ways. Clean material is used to remediate an old ocean disposal site called the Mud Dump site, while dredged material not suitable for that site is placed in a confined disposal facility within the NY/NJ harbor at a cost of $29 per cubic yard. "But we want something that offers a more infinite capacity for treating dredged material," says Douglas. "Decontamination is almost like a manufacturing process — you remove the contaminants and produce marketable products such as construction-grade cement, lightweight aggregate and clean topsoils. The processes we are considering transform dredged sediments into value-added products that help recoup the cost of the decontamination technology itself."

"What is learned and applied to the NY/NJ harbor system can potentially be transferred anywhere that contaminated sediments are a problem, such as the Great Lakes," says Eric Stern, EPA's regional contaminated sediment/WRDA program manager. "This includes not only navigable channels but possibly areas outside of these channels such as Superfund areas and impacted areas where environmental dredging and environmental restorations may be desired.

"The WRDA/NJMR programs have applicability in other ports around the country such as Baltimore and Seattle," continues Stern, "and in Italy at the Port and Lagoon of Venice and in Germany for the Rhine and Port of Hamburg."

Research resources

- For information about the WRDA-sponsored NY/NJ harbor sediment decontamination program and contaminated sediments in Region 2, contact Eric Stern at 212-637-3806; e-mail, stern.eric@epamail.epa.gov.
- Information on USACE dredging and decontamination work is available from James Lodge at 212-264-4549; e-mail, James.Lodge@nan02.usace.army.mil.
- To learn more about the sediment treatment research at BNL, contact Keith Jones at 631-344-4588; e-mail, kwj@bnl.gov. Reports and publications related to the decontamination project can be found at *www.wrdadcon.bnl.gov*.
- For more information on the programs at the N.J. Office of Maritime Resources, contact Scott Douglas at: 609-984-8564; e-mail, Scott.Douglas@dot.state.nj.us; *www.state.nj.us/transportation/maritime*.
- Visit EPA's Office of Science and Technology website at *www.epa.gov/OST/cs* for facts about contaminated sediment.